American Museum Novitates

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET, NEW YORK 24, N.Y.

NUMBER 1909 AUGUST 13, 1958

Pleistocene Invertebrates from Punta Baja, Baja California, Mexico

By William K. Emerson[1] and Warren O. Addicott[2]

INTRODUCTION

The present paper records marine invertebrates from late Pleistocene terrace deposits in the vicinity of Punta Baja, Baja California, Mexico (latitude 29° 57′ N.). The presence of these deposits has been noted previously by Valentine (1955, p. 465) and by Emerson (1956b, p. 319), but the fossils were not enumerated. Paleoecologic interpretations are undertaken based on a collected fauna of 74 metazoan species and subspecies, and faunal comparisons are made with other late Pleistocene assemblages described from northwestern Baja California.

Although relatively small in number of species, the Punta Baja fauna is particularly significant ecologically. This assemblage is the southernmost known occurrence in this region of the "cool-water," open-coast, depositional facies. Along the extreme northern portion of the peninsula, open-coast faunas are recorded from deposits on the lowest terrace platform occurring at: (1) the International Border (Emerson and Addicott, 1953), (2) Punta Descanso (Valentine, 1957), (3) Punta China (Emerson, 1956b), (4) Punta Cabras (Addicott and Emerson, MS), and (5) the present locality. Along this portion of the coast line, a protected bay assemblage is known only from the San Quintín Bay area (Jordan, 1926). (See fig. 1 for localities mentioned.)

1 The American Museum of Natural History, New York.
2 General Petroleum Corporation, Los Angeles.

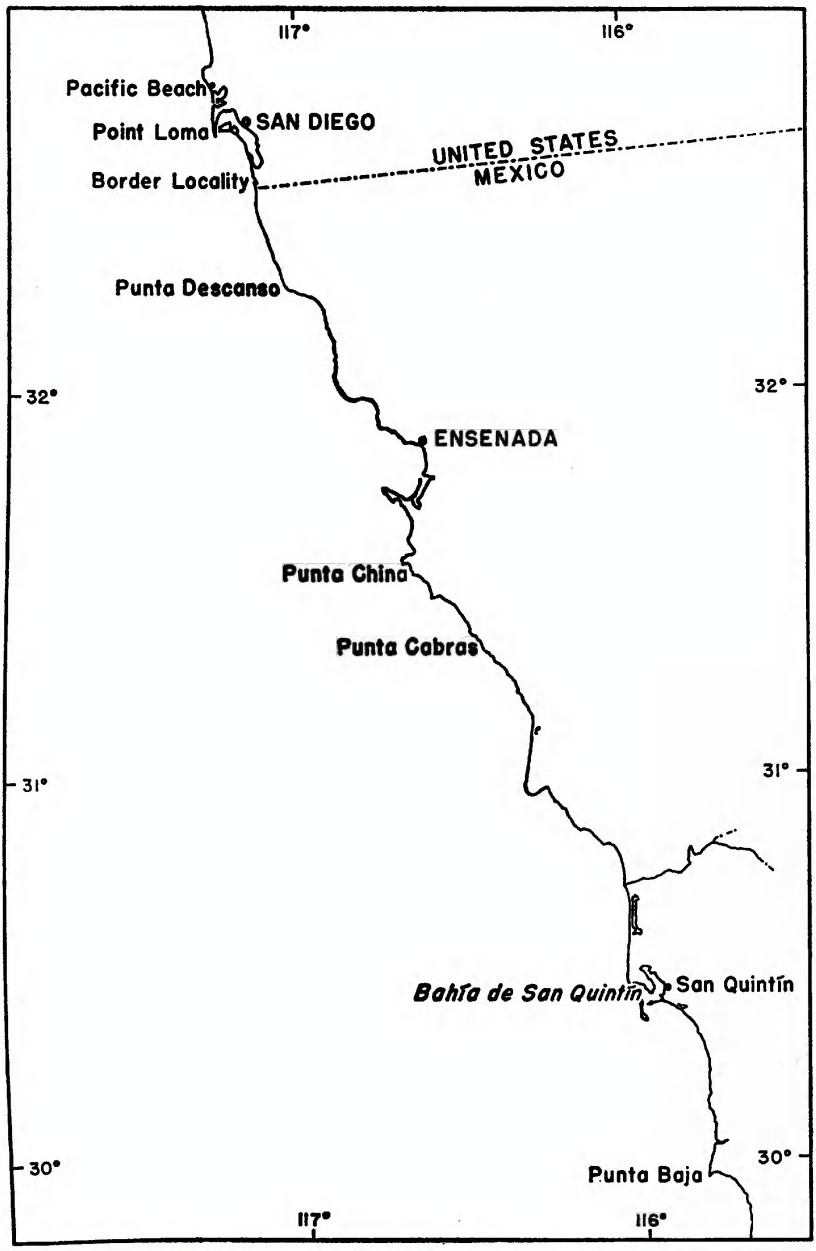

FIG. 1. Index map showing location of the principal localities mentioned in the text.

Punta Baja is a small headland, about 30 feet in elevation, situated 10 miles southwest of the inland village of El Rosario. This narrow point of land is the southern culmination of a 25-mile stretch of north to south trending coast line, providing a protection from northwest weather for Bahía Rosario to the east. At Punta Baja the coast line makes a right-angle bend that runs some 3 miles in an easterly direction and then gradually curves southward to Punta San Antonio, a distance of approximately 15 miles. This part of the coast "consists of sand bluffs 50–100 feet high, backed at a distance of 1½ to 2 miles by hills 300 to 500 feet high . . ." (United States Hydrographic Office, 1951, p. 37). The "sand bluffs" are doubtlessly a southern continuation of the Punta Baja terrace platform. The coast line immediately north of the headland is broken by a number of small erosional gullies; the shore is composed largely of boulders and cobbles. East of the promontory, the coast line forms a nearly continuous sandy beach, with occasional rocks and boulders.

Beal (1948) mapped continuous exposures of the upper Cretaceous Rosario formation in the sea cliffs and arroyos from Punta Baja to Rio Socorro, some 25 miles to the north. The predominant lithology of local outcrops of the Rosario rocks underlying the late Pleistocene terrace deposits is red, well-indurated, cobble conglomerate. The conglomerate is probably correlative with Santillán and Barrera's (1930) lowest red conglomeratic sand member of the Rosario formation originally described from Arroyo Rosario a few miles to the north. A fossil collected by the senior author from the conglomerate near locality A-9590 has been identified by Oakes (MS) as *Turritella chicoensis perrini* Merriam. This species is limited in range to the upper Cretaceous Chico stage of the marine Mesozoic of the Pacific coast (Merriam, 1941).

The Pleistocene wave-cut terrace platform is exposed in the sea cliff at about 12 to 15 feet above sea level. Along the shore, marine deposits are largely eroded off the platform, but depositional remnants are locally preserved overlying the upper Cretaceous conglomerate. South of the headland, fossils occur in poorly sorted, sandy gravel in deposits 1 to 4 feet thick (A-9590, A-9591). North of the point, fossils were collected in fine-grained, well-sorted sand, forming deposits locally 10 to 12 feet in thickness (A-9592, B-1376).

DESCRIPTIONS OF COLLECTING STATIONS IN THE PUNTA BAJA TERRACE

The writers visited the Punta Baja area and collected the fossils in 1953 under the generous sponsorship of the University of Cali-

fornia Museum of Paleontology. The United States Hydrographic Office San Diego to Bahía San Quintín Chart, no. 1149, edition 45, scale 1:290,000, was the best base map available for use in the field. Accurate map designation of localities from which fossils were collected could not be made on this base because of limitations of scale and form-line topographic contours. In the field, collecting localities could best be relocated by reference to local shore-line configuration.

More recently the Punta Baja localities have been transferred to a more detailed base map: United States Hydrographic Office Bahía del Rosario and Arrecife Sacramento Chart, No. 1044, inset E, with a scale of 1:72,000 (see fig. 2). Locality numbers refer to collections contained in the Museum of Paleontology, University of California, Berkeley.

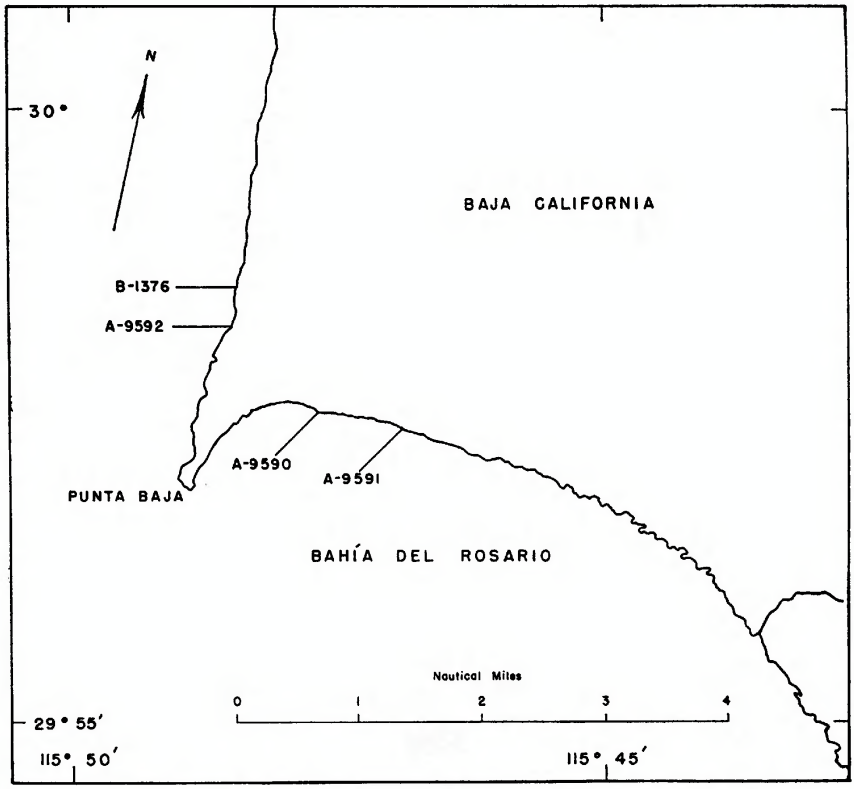

FIG. 2. Sketch map of the coast line of the Punta Baja area showing the approximate location of the principal collecting stations mentioned in the text (base after United States Hydrographic chart no. 1044, insert E).

A-9590: Latitude 29° 57.5′ N., longitude 115° 47.6′ W. First prominent point east of Punta Baja. Collection from 4-foot-thick bed of unconsolidated, poorly sorted, sandy gravel overlying upper Cretaceous boulder and cobble conglomerate. Base of terrace deposit occurs about 12 to 15 feet above sea level. Collected by W. O. Addicott, February, 1953.

A-9591: At mouth of small gully on north shore of Bahía del Rosario less than 1 mile east of A-9590. Abundantly fossiliferous bed of sandy gravel from 1 to 4 feet thick with rounded boulders to 18 inches in diameter at base. Wave-cut platform exposed in sea cliff about 12 feet above sea level. Collected by W. K. Emerson and W. O. Addicott, February, 1953.

A-9592: Approximate coordinates: Latitude 29° 58.2′ N., longitude 115° 48.4′ W. In low sea cliffs at back of narrow, sandy beach about 1 mile north of Punta Baja. Collection from 6-foot-thick bed of unconsolidated sandy gravel characterized by an abundance of *Mytilus californianus*. The sand is fine grained, well sorted, and clean. The contact with upper Cretaceous conglomerate is channeled at the south end of the pocket beach where the marine sediments are 10 to 12 feet thick. Collected by W. K. Emerson and W. O. Addicott, February, 1953.

B-1376: Low sea cliff immediately north of the point where the rocky reef (exposed at low tide) north of A-9592 meets the shore. Unconsolidated, fine-grained, well-sorted sand overlying upper Cretaceous conglomerate. Less than one-half of a mile north of A-9592. Collected by W. O. Addicott, February, 1953.

COMPOSITION AND INFERRED SIGNIFICANCE OF THE PUNTA BAJA FAUNA

The collected fauna contains 74 metazoan specific and infraspecific taxa of which nine are of uncertain identity. The mollusks, totaling 67 species, constitute the major part of the fauna, with 48 species of gastropods and 19 species of pelecypods. Of the remaining taxa, two are echinoids, three are barnacles, and two are bryozoans. No special attempt was made to collect minute organisms.

The Punta Baja fauna is enumerated by collecting stations in table 1. Ecological requirements of the components comprising the four collections are similar enough to permit discussion of the fauna as a unit. The general composition of the fauna suggests deposition along a coast very much like the present one, a series of sand and rock-rubble beaches separated by rocky headlands. This interpretation is corroborated by the preponderance of tide-pool and rock-cliff elements in the fauna and by the composition of the terrace sediments. At the present time most of the constituent species inhabit the intertidal zone or shallow infratidal waters of the inner neritic zone of an open coast. Only one species, *Bursa californica*, is not known to occur in depths of less than 10 fathoms. This species, which is recorded to live

in depths of 10 to 50 fathoms off California, is represented at only one collecting station. The specimens are fragmental, indicating probable transport by storm waves.[1] On the basis of the ecologic data available for most of the mollusks, 72 and 69 per cent of the gastropods and pelecypods, respectively, require rock or rock-rubble substrates. The remaining species are sand dwellers or ubiquitous forms. Of the other phyla represented in the collections, only the echinoid *Dendraster* sp. (*D. ?excentricus*) inhabits a sand bottom; the rest require rocky substrates.

Although the fauna is composed of extant species,[2] it contains, in common with other open-coast, terrace assemblages of southern California and northern Baja California, a conspicuous, "northern," cool-water element. These species, listed in table 2, live at the present time north of Punta Baja (latitude 29° 57′ N.). Several of these do not occur on the mainland south of Point Conception, California (latitude 32° 27′ N.), or occur intertidally only in local areas of intense upwelling (Valentine, 1955; Emerson, 1956a). None of the warm-water species, which characterize the protected bay assemblages of certain terrace deposits of southern California and a similar assemblage at San Quintín Bay, are present in the Punta Baja fauna. The presence of the shallow-water, northern element in the assemblage indicates that water temperatures required to support the fauna were colder than those now existing at this latitude, which Dawson (1951) has demonstrated to be at the present time a site of seasonal upwelling. On the basis of the composition of the Punta Baja fauna alone, however, it is obviously impossible to determine if the lower paleotemperature requirements reflect a southward isothermal shift along the coast, the influence of local upwelling, or a combination of these two factors.

Both the stratigraphic and faunistic evidence suggests a late Pleistocene age for the deposit. The deposit is topographically the lowest raised terrace of marine origin in the area and would appear to be correlative with terrace remnants of approximately the same elevation

[1] Living specimens of this species are commonly found washed ashore along the southern California coast after storms. This suggests at least a seasonable occurrence in depths shallower than 10 fathoms.

[2] One species, *Nassarius delosi*, which was described from the Palos Verdes sands and is known to occur in late Pleistocene deposits at San Diego (Woodring, *in* Emerson and Addicott, 1953, p. 439), Punta Descanso (Valentine, 1957), Punta Cabras (Addicott and Emerson, MS), and San Quintín Bay (Chace, 1957), was believed to be extinct. Chace (1957, p. 108), however, reported a living specimen from Balboa, California.

TABLE 1

CHECK LIST OF THE PUNTA BAJA FAUNA

	Locality Nos. A-9590	A-9591	A-9592	B-1376
GASTROPODA				
Acanthina lugubris (Sowerby, 1821)	x	—	—	x
Acanthina spirata (Blainville, 1832)	x	x	—	—
Acmaea asmi Middendorff, 1847	—	—	x	—
Acmaea digitalis Eschscholtz, 1833	—	—	x	—
Acmaea mitra Eschscholtz, 1833	x	x	x	x
Acmaea paleacea Gould, 1853	x	—	—	—
Acmaea pelta Eschscholtz, 1833	x	x	—	x
Acmaea scabra (Gould, 1846)	x	x	x	—
Acmaea scutum Eschscholtz, 1833	—	x	—	—
Aletes squamigerus Carpenter, 1856	x	—	x	x
Amphissa versicolor Dall, 1871	—	—	x	x
Bittium cf. *B. quadrifilatum* Carpenter, 1864	—	—	x	—
Bursa californica Hinds, 1843	x	—	—	—
Calliostoma ligatum Gould, 1852 = *C. costatum* Martyn, 1784	x	—	x	—
Conus californicus Hinds, 1844	x	x	x	x
Crepidula adunca Sowerby, 1825	x	x	x	x
Crepidula cf. *C. lingulata* Gould, 1846	x	—	—	—
Crepidula nivea C. B. Adams, 1852	—	—	x	x
Diodora aspera (Eschscholtz, 1833)	—	—	x	x
Diodora inaequalis (Sowerby, 1835)	x	—	—	—
Epitonium sp. indet.	—	—	x	—
Fissurella volcano Reeve, 1849	x	—	—	—
Gadinia reticulata (Sowerby, 1835)	—	—	x	—
Hipponix antiquatus (Linnaeus, 1767)	x	—	—	—
Homalopoma carpenteri (Pilsbry, 1888)	—	—	x	—
Jaton festiva (Hinds, 1844)	x	?	—	—
Littorina planaxis Nuttall, 1847	—	—	x	x
Littorina scutulata Gould, 1849	x	x	x	x
Lottia gigantea Gray, 1834	x	—	x	—
Maxwellia gemma (Sowerby, 1879)	x	—	—	—
Mitra idae Melville, 1893	x	x	—	x
Mitrella carinata (Hinds, 1844)	—	—	x	x
Mitrella carinata gausapata (Gould, 1851)	x	x	x	—
Nassarius delosi (Woodring, 1946)	x	x	—	—
Nassarius fossatus (Gould, 1849)	x	x	—	—
Nassarius mendicus cooperi (Forbes, 1850)	—	—	x	—
Ocinebra lurida (Eschscholtz, 1833)	—	—	—	x

TABLE 1—(*Continued*)

	Locality Nos.			
	A-9590	A-9591	A-9592	B-1376
Ocinebra poulsoni Carpenter, 1865	—	x	—	—
Olivella biplicata (Sowerby, 1825)	x	—	—	—
Opalia wroblewskyi chacei Strong, 1937	—	—	—	x
Polinices cf. *P. lewisi* (Gould, 1847)	x	x	—	—
Pusula californianus (Gray, 1863)	—	x	—	—
Tegula brunnea Philippi, 1848	x	x	x	x
Tegula funebralis (A. Adams, 1859)	x	x	x	x
Tegula cf. *T. gallina* (Forbes, 1850)	x	—	—	—
"*Tegula*" *montereyi* (Fischer, 1880)	x	x	—	—
Thais emarginata (Deshayes, 1839)	—	—	x	x
Zonaria spadicea (Swainson, 1823)	x	—	—	—
PELECYPODA				
Anomia peruviana d'Orbigny, 1846	—	x	—	—
Chama pellucida Broderip, 1835	x	x	x	—
Cryptomya californica (Conrad, 1837)	x	—	x	—
Glans carpenteri (Lamy, 1922)	—	x	x	—
Hinnites multirugosus (Gale, 1928)	x	x	x	—
Macoma irus Hanley, 1845	—	x	x	x
Macoma nasuta (Conrad, 1837)	—	—	x	—
Macoma nasuta kelseyi Dall, 1900	—	—	x	—
Modiolus fornicatus (Carpenter, 1864)	—	—	x	—
Mytilus californianus Conrad, 1837	x	—	x	x
Petricola carditoides (Conrad, 1837)	x	—	x	—
Pododesmus macroschismus (Deshayes, 1839)	x	x	x	x
Protothaca staminea (Conrad, 1837)	x	x	x	x
Protothaca staminea var. *orbella* (Carpenter, 1864)	—	—	x	—
Pseudochama exogyra (Conrad, 1837)	x	—	—	—
Schizothaerus nuttalli (Conrad, 1837)	x	x	x	—
Semele cf. *S. decisa* (Conrad, 1837), juvenile	x	—	—	—
Transennella tantilla (Gould, 1853)	—	—	x	—
Zirfaea pilsbryi Lowe, 1931	x	x	—	—
ECHINOIDEA				
Dendraster sp.	x	—	—	—
Strongylocentrotus sp.	x	—	x	x
CIRRIPEDIA				
Balanus aff. *B. aquila* Pilsbry, 1907	x	—	—	x
Balanus cf. *B. nubilus* Darwin, 1854	x	x	—	—
Balanus cf. *B. tintinnabulum californicus* Pilsbry, 1916	x	x	—	x

TABLE 1—(*Continued*)

	Locality Nos.			
	A-9590	A-9591	A-9592	B-1376
BRYOZOA[a]				
Cauloramphus spiniferum (Johnston, 1832)	—	—	x	—
Microporella californica (Busk, 1856)	—	—	x	—

[a] Identifications contributed by Dr. John D. Soule, Allan Hancock Foundation University of Southern California.

occurring to the north along the present coast line to the International Border. The fauna, though totally modern in composition, contains "northern" constituents which are not living at the present time as far south as this latitude.

Viewed in terms of the known Quaternary history of the Pacific coast, it may be postulated that the Punta Baja fauna was deposited during a phase when protected waters were warm enough to support warm-water assemblages in the shallow-water embayments, and coastal upwelling was of a magnitude sufficient to support cold-water assem-

TABLE 2

LOCALLY EXTINCT "NORTHERN" MOLLUSKS IN THE PUNTA BAJA FAUNA, WITH SOUTHERN END POINT OF PRESENT RANGE INDICATED

GASTROPODA	
Acmaea asmi	Todos Santos Bay, Baja California
Acmaea mitra	Punta Santo Tomás, Baja California
Acmaea scutum	Santa Barbara, California
Calliostoma ligatum	San Luis Obispo County, California
Mitra idae	Cortez Bank, off San Diego, California
Nassarius delosi	Balboa Beach, California (Chace, 1957)
Nassarius mendicus cooperi	San Diego, California
Ocinebra lurida	Santa Catalina Island, California
Opalia wroblewskyi chacei	San Diego, California
Tegula brunnea	Santa Barbara Islands, California
"Tegula" montereyi	Santa Barbara Islands, California
PELECYPODA	
Glans carpenteri	Todos Santos Bay, Baja California
Macoma irus	San Pedro, California
Macoma nasuta kelseyi	Puget Sound, Washington
Modiolus fornicatus	Todos Santos Bay, Baja California

blages in local coastal sites. Similar distributional patterns are known to exist at the present time along the southwestern coast of Baja California, where relict, warm-water elements are now confined to the shallow, warm-water lagoons, and "northern," cool-water elements inhabit local sites of upwelling on the open coast (Emerson, 1956b).

LITERATURE CITED

ADDICOTT, WARREN O., AND WILLIAM K. EMERSON
[MS.] Late Pleistocene invertebrates from Punta Cabras, Baja California, Mexico.

BEAL, CARL H.
1948. Reconnaissance of the geology and oil possibilities of Baja California, Mexico. Mem. Geol. Soc. America, no. 31, ix+138 pp., 11 pls.

CHACE, E. P.
1957. *Nassa delosi* Woodring. Nautilus, vol. 70, p. 108.

DAWSON, E. YALE
1951. A further study of upwelling and associated vegetation along Pacific Baja California, Mexico. Jour. Marine Res., vol. 10, pp. 39–58, 6 figs.

EMERSON, WILLIAM K.
1956a. Upwelling and associated marine life along Pacific Baja California, Mexico. Jour. Paleont., vol. 30, pp. 393–397, 1 fig.
1956b. Pleistocene invertebrates from Punta China, Baja California, Mexico, with remarks on the composition of the Pacific coast Quaternary faunas. Bull. Amer. Mus. Nat. Hist., vol. 111, pp. 313–342, 1 fig., pls. 22, 23.

EMERSON, WILLIAM K., AND WARREN O. ADDICOTT
1953. A Pleistocene invertebrate fauna from the southwest corner of San Diego County, California. Trans. San Diego Soc. Nat. Hist., vol. 11, pp. 429–444, 1 map.

JORDAN, ERIC KNIGHT
1926. Molluscan fauna of the Pleistocene of San Quintin Bay, Lower California. Proc. California Acad. Sci., ser. 4, vol. 15, pp. 241–255, 1 fig., 1 pl.

MERRIAM, CHARLES W.
1941. Fossil turritellas from the Pacific coast region of North America. Univ. California Publ., Bull. Dept. Geol. Sci., vol. 26, pp. 1–214, 19 figs., pls. 1–41, 1 map.

OAKES, MILLIS HENRY
[MS.] Upper Cretaceous of Cabo Cabras, Baja California. (Unpublished M.A. thesis, University of California, 86 pp., 3 pls., 1954.)

SANTILLÁN, MANUEL, AND TOMÁS BARRERA
1930. Las posibilidades petrolíferas en la costa occidental de la Baja California, entres los paralelos 30° y 32° de latitud norte. An. Inst. Geol. Mexico, vol. 5, pp. 1–37, 12 figs.

UNITED STATES HYDROGRAPHIC OFFICE
1951. Sailing directions for the coasts of Mexico and Central America. Washington, D. C., Publ. no. 84, ed. 9, xii+308 pp.

VALENTINE, JAMES W.
1955. Upwelling and thermally anomalous Pacific coast Pleistocene molluscan faunas. Amer. Jour. Sci., vol. 253, pp. 462–474.
1957. Late Pleistocene faunas from the northwestern coast of Baja California, Mexico. Trans. San Diego Soc. Nat. Hist., vol. 12, pp. 289–308, figs. 1–6.